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PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements in or relating to Heat Exchangers

We, ASSOCIATED ENGINEERING LIMITED, a British Company of 60, Kenilworth Road, Leamington Spa, Warwickshire, do hereby declare this invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to heat exchangers, and more particularly to core constructions for the radiators of liquid cooled internal combustion engines.

Heat exchanger, for example the cores of radiators for liquid cooled internal combustion engines, generally comprise a plurality of passages for the liquid coolant which are constituted by a plurality of individual tubes arranged in rows and extending between tube plates, forming part of end shells or tanks, into which the opposite ends of the tubes are secured. The tubes are provided with, or are in contact with, cooling surfaces such as fins for dissipating heat transferred to the tubes from the liquid passing therethrough from one end tank to the other.

It is an object of the present invention to provide an improved heat exchanger construction which is made from metal foil, that is to say, sheet material having a thickness up to approximately 0.012 inches.

To this end the invention consists in a heat exchanger comprising a series of members made from metal foil (as hereinbefore defined) which are spaced apart to permit the flow of a first fluid therebetween, each member being formed from a pair of sheet-like metal foil elements which are assembled face-to-face and bonded together by an adhesive, at least one of said pair being shaped so as to define one or more passages within said member through which a second fluid can flow, and wherein the space between adjacent members contains cooling surfaces in the form of fins extending generally transversely to said members and formed by areas of a strip of metal foil which is bonded by an adhesive to said adjacent members at regions between said areas, said fins being inclined with respect to each other.

Each member may comprise a pair of sheet-like elements, at least one of which is formed with at least one channel therein, which, with the other sheet-like element, defines a passage or passages. The two elements of each pair may both be formed with at least one channel which, when the two elements are adhesively bonded together face-to-face, are preferably but not essentially aligned with each other.

The opposite ends of each of the passages may be flanged, the flanges being adhesively bonded to apertured plates extending across the ends of the members, so that each end of each passage is in alignment with an aperture in a plate.

The strips of metal foil may be corrugated in a zig-zag form about axes extending generally in the direction of flow of the first fluid.

The fins may be provided with dimples, louvres, perforations or other means to increase their heat exchange relationship with the first fluid flowing over them.

Advantageously, the metal foil is an aluminium foil. It will be understood that the term "aluminium foil" includes alloys of aluminium.

In order that the invention may be more readily understood, reference will now be made to the accompanying drawings in which:

Figure 1 is a cross-section, in a plane transverse to the axes of the liquid passages, of a part of one embodiment of radiator core constructed in accordance with the present invention, and

Figure 2 is a longitudinal section along the line II—II in Figure 1,

Referring to the drawings, the radiator core is assembled from a plurality of members, each

[*Price 4s. 6d.*]

comprising a pair of thin sheet-like elements 1, for example sheet of aluminium foil having a thickness of up to approximately 0.012 . Aluminium foil having a thickness of about 0.005 has been successfully used. Each element 1, is formed, for example by rolling, with a number of parallel channels 2 extending between opposite edges of the element, and separated by flat lands 3. Pairs of elements 1 are assembled together with the channels 2 of one element in alignment with the channels 2 of the other element, so that each pair of opposed channels defines a liquid passage or tube 4.

The pairs of elements each constituting an integral row of liquid passages or tubes are secured to tube plates 5, preferably formed from aluminium sheet, by flanges 6 disposed at the ends of the passages 4, with the open ends of the passages 4 in alignment with apertures or slots 7 in the tube plates 5. Between each pair of elements, which extend in the direction of air flow through the radiator core when in use, are located cooling surfaces comprising fins 8 which are inclined with respect to each other, the fins between each adjacent pair of elements being preferably formed of a single corrugated strip of aluminium foil. This corrugated strip may be provided with dimples, louvres, perforations, or other means (not shown) to induce turbulence of the air passing through the core, and may be notched or recessed at the tips of the corrugations to receive the adjacent wall portions of the passages or tubes 4.

Extending between the tube plates 5, and secured to the opposite lateral edges of the core, are core end plates 9 formed for example of aluminium foil or sheet which protect the outermost fins or elements 1 against damage. These core end plates 9 may also be secured to the tube plates 5 by flanges 10 at opposite ends of the plates 9.

The core components are assembled by means of an adhesive which is preferably a heat curable adhesive. The aluminium foil and sheet from which the components are formed may be pre-coated with the adhesive on at least one surface thereof, but it is also possible, alternatively or additionally, to apply the adhesive to the mating surfaces of the components during assembly thereof.

The core may be assembled as follows:—

The sheet-like elements 1 formed with channels 2 and lands 3 are assembled in pairs with their channels 2 in alignment, and the lands 3 are pressed together whilst heat is applied to the sheets to cure the adhesive. The rows of integral liquid passages or tubes 4 thus formed are then bonded to the fins 8 by stacking the rows of tubes and the fins alternatively, an adhesive being run between the mating surfaces of the tips of the fins 8 and the tubes 4. The stack may be compressed, whilst being heated to cure the adhesive to ensure intimate contact between the tips of the fins and the tubes 4. The core end plates 9 may be adhesively bonded to the lateral edges of the core during this operation.

The tube plates 5, provided with slots 7 are then positioned at each end of the core in engagement with the flanges 6 and 10 with the slots 7 in alignment with the open ends of the passages or tubes 4. The plates 5 are then pressed against the core whilst the adhesive between the flanges 6 and 10 and the plates 5 is cured.

It will be seen that the core hereinbefore described, comprising the sheet-like elements 1, fins 8, tube plates 5 and core end plates 9, may be formed entirely from adhesively bonded aluminium foil.

It will be understood that various modifications may be made without departing from the scope of the present invention. For example the passages or tubes may be of any desired cross-section, and the channels 2 may be formed in one sheet-like element only of each pair, the other element of each pair being flat.

In addition or alternatively to providing the fins 8, apertures may be formed in the lands 3, or portions of the lands may be stamped or cut and deformed to project into the spaces between adjacent members.

Furthermore, one or both of the tube plates may be formed with integral side walls forming part of a tank at the end of the core.

WHAT WE CLAIM IS:—

1. A heat exchanger comprising a series of members made from metal foil (as hereinbefore defined) which are spaced apart to permit the flow of a first fluid therebetween, each member being formed from a pair of sheet-like metal foil elements which are assembled face-to-face and bonded together by an adhesive, at least one of said pair being shaped so as to define one or more passages within said member through which a second fluid can flow, and wherein the space between adjacent members contains cooling surfaces in the form of fins extending generally transversely to said members and formed by areas of a strip of metal foil which is bonded by an adhesive to said adjacent members at regions between said areas, said fins being inclined with respect to each other.

2. A heat exchanger as claimed in claim 1, in which each strip of metal foil is corrugated in a zig-zag form about axes extending generally in the direction of the flow of the first fluid.

3. A heat exchanger as claimed in claim 1 or 2, in which each member comprises a pair of sheet like elements, at least one of which is formed with at least one channel therein which, with the other sheet like element defines a passage or passages.

4. A heat exchanger as claimed in claim 3, in which the two elements of each pair are both formed with at least one channel which,

when the two elements are bonded together face-to-face are aligned with each other.

5. A heat exchanger as claimed in any preceding claim, in which the opposite ends of each of the passages are flanged, the flanges being adhesively bonded to apertured plates extending across the ends of the members so that each end of each passage is in alignment with an aperture in a plate.

6. A heat exchanger as claimed in any preceding claim, in which the fins are provided with dimples, louvres, perforations or other means to increase their heat exchange relationship with the first fluid flowing over them.

7. A heat exchanger as claimed in any preceding claim, in which the components thereof are formed from aluminium foil.

8. A heat exchanger substantially as hereinbefore described with reference to the accompanying drawings.

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1 SHEET

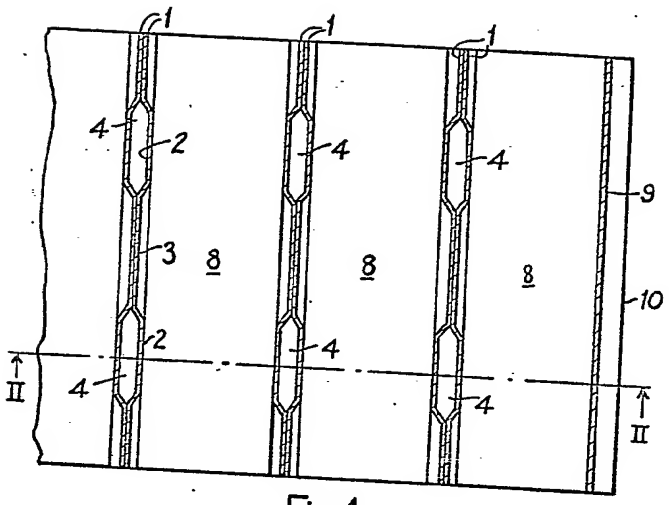

Fig.1

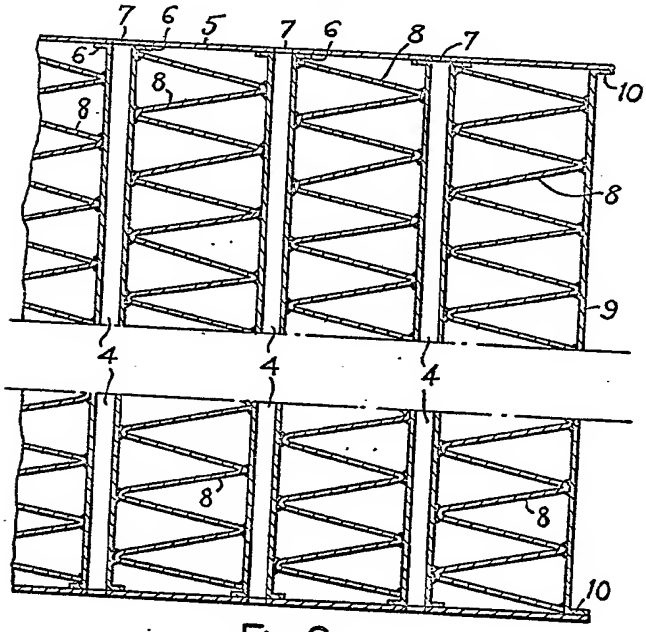

Fig.2